

What is claimed is:

1 1. A GPS (Global Positioning System) microstrip antenna
2 mounted on a projectile comprising:

3 (a) a first rectangular shaped dielectric layer;

4 (b) a plurality of square shaped antenna elements mounted
5 on an upper surface of said first dielectric layer, said
6 antenna elements being aligned with one another and fabricated
7 from copper, each of said antenna elements being positioned at
8 an angle of approximately forty five degrees on said first
9 dielectric layer, said antenna elements being adapted to
10 receive GPS (Global Positioning System) data at a frequency of
11 approximately 1.575 GHz;

12 (c) an antenna feed network mounted on a bottom surface of
13 said first dielectric layer, said antenna feed network having a
14 main transmission line connected to a signal output for said
15 GPS microstrip antenna, said feed network having a plurality of
16 branch transmission lines connected to said main transmission
17 line and each of said antenna elements, each of said branch
18 transmission lines including a pair of probes positioned
19 perpendicular to one another underneath one antenna element of
20 said plurality of antenna elements, one of said pair of probes
21 for each of said branch transmission lines having a length

substantially greater than the other of said pair of probes for each of said branch transmission lines to provide for a ninety degree relative phase shift between RF signals transmitted through said pair of probes for each of said pair of branch transmission lines resulting in a circular polarization and an omni-directional radiation pattern being generated by said antenna elements of said GPS microstrip antenna;

(d) a pair of identical filters integrally formed within said main transmission line, said pair of identical filters isolating GPS radio frequency signals from TM band signals over a frequency range from about 2 GHz to about 7 GHz;

(e) a diode limiter connected to said main transmission line in proximity to said signal output for said feed network; and

(f) an amplifier connected to said main transmission line in proximity to said signal output for said feed network, said diode limiter and said amplifier providing for an overall gain of approximately 27 decibels.

2. The GPS microstrip antenna of claim 1 further comprising a continuous gap formed around first, second, third and fourth sides of each of said antenna elements, said

4 continuous gap for each of said antenna elements having an
5 electric field generated by said antenna element confined to
6 said continuous gap.

1 3. The GPS microstrip antenna of claim 2 further
2 comprising a copper plated ground mounted on a remaining
3 portion of the upper surface of said first dielectric layer
4 around the continuous gap for each of said antenna elements.

1 4. The GPS microstrip antenna of claim 3 further
2 comprising a second dielectric layer positioned below said
3 first dielectric layer in alignment with said first dielectric
4 layer, said second dielectric having a ground plane mounted on
5 a bottom surface thereof.

1 5. The GPS microstrip antenna of claim 4 wherein said
2 copper plated ground mounted on the upper surface of said first
3 dielectric layer is connected to the ground plane mounted on
4 the bottom surface of said second dielectric layer by a
5 plurality of vias which pass from said copper plated ground
6 through said first dielectric layer and said second dielectric

7 layer to said ground plane.

1 6. The GPS microstrip antenna of claim 1 wherein said pair
2 of identical filters each comprise a 5-Section Band Stop Filter
3 and a 7-Section Low Pass Filter.

1 7. The GPS microstrip antenna of claim 1 wherein each of
2 said antenna elements includes a pair of tuning stubs located
3 on adjacent sides of said antenna element, said pair of tuning
4 stubs for each of said antenna elements allowing said antenna
5 elements to be fine tuned to an operating frequency for said
6 GPS microstrip antenna.

1 8. The GPS microstrip antenna of claim 1 wherein said
2 signal output for said feed network comprises a fifty ohm
3 signal output for said feed network.

1 9. The GPS microstrip antenna of claim 4 wherein said
2 dielectric layer comprises a circuit board and said second
3 dielectric layer comprises a ground board, said circuit board
4 and said ground board each having an overall dimension of 5.7
5 inches in width and approximately 27 inches in length.

1 10. A GPS (Global Positioning System) microstrip antenna
2 mounted on a projectile comprising:

3 (a) a first rectangular shaped dielectric layer;

4 (b) a plurality of square shaped antenna elements mounted
5 on an upper surface of said first dielectric layer, said
6 plurality of antenna elements being aligned with one another
7 and fabricated from copper, each of said plurality of antenna
8 elements being positioned at an angle of approximately forty
9 five degrees on said first dielectric layer, said plurality of
10 antenna elements being adapted to receive GPS (Global
11 Positioning System) data at a frequency of approximately 1.575
12 GHz;

13 (c) each of said plurality of antenna elements including a
14 pair of tuning stubs located on adjacent sides of said antenna
15 element, said pair of tuning stubs for each of said plurality
16 of antenna elements allowing said plurality of antenna elements
17 to be fine tuned to an operating frequency for said GPS
18 microstrip antenna;

19 (d) an antenna feed network mounted on a bottom surface of
20 said first dielectric layer, said antenna feed network having a
21 main transmission line connected to a signal output for said

GPS microstrip antenna, said feed network having a plurality of branch transmission lines connected to said main transmission line at one end thereof, the opposite end of each of said branch transmission lines including a pair of probes positioned perpendicular to one another underneath one antenna element of said plurality of antenna elements, one of said pair of probes for each of said branch transmission lines having a length substantially greater than the other of said pair of probes for each of said branch transmission lines to provide for a ninety degree relative phase shift between RF signals transmitted through said pair of probes for each of said pair of branch transmission lines resulting in a circular polarization and an omni-directional radiation pattern being generated by said plurality of antenna elements of said GPS microstrip antenna;

(e) a pair of identical filters integrally formed within said main transmission line, said pair of identical filters isolating GPS radio frequency signals from TM band signals over a frequency range from about 2 GHz to about 7 GHz, each of said pair of filters including a low pass filter and a band stop filter;

(f) a diode limiter connected to said main transmission line in proximity to said signal output for said feed network;

44 (g) an amplifier connected to said main transmission line
45 in proximity to said signal output for said feed network, said
46 diode limiter and said amplifier providing for an overall gain
47 of approximately 27 decibels; and

48 (h) a second dielectric layer positioned below said first
49 dielectric layer in alignment with said first dielectric layer,
50 said second dielectric layer having a ground plane mounted on a
51 bottom surface thereof.

1 11. The GPS microstrip antenna of claim 10 further
2 comprising a continuous gap formed around first, second, third
3 and fourth sides of each of said plurality of antenna elements,
4 said continuous gap for each of said plurality of antenna
5 elements having an electric field generated by said antenna
6 element confined to said continuous gap.

1 12. The GPS microstrip antenna of claim 11 further
2 comprising a copper plated ground mounted on a remaining
3 portion of the upper surface of said first dielectric layer
4 around the continuous gap for each of said plurality of antenna
5 elements.

1 13. The GPS microstrip antenna of claim 12 wherein said
2 copper plated ground mounted on the upper surface of said first
3 dielectric layer is connected to the ground plane mounted on
4 the bottom surface of said second dielectric layer by a
5 plurality of vias which pass from said copper plated ground
6 through said first dielectric layer and said second dielectric
7 layer to said ground plane.

1 14. The GPS microstrip antenna of claim 10 wherein said
2 band stop filter for each of said pair of identical filters
3 comprises a 5-Section Band Stop Filter and said low pass filter
4 for each of said pair of identical filters comprises a
5 7-Section Low Pass Filter.

1 15. The GPS microstrip antenna of claim 10 wherein said
2 signal output for said feed network comprises a fifty ohm
3 signal output for said feed network.

1 16. The GPS microstrip antenna of claim 10 wherein said
2 dielectric layer comprises a circuit board and said second
3 dielectric layer comprises a ground board, said circuit board
4 and said ground board each having an overall dimension of 5.7

5 inches in width and approximately 27 inches in length.

1 17. A GPS (Global Positioning System) microstrip antenna
2 mounted on a projectile comprising:

3 (a) a first rectangular shaped dielectric layer;

4 (b) eight square shaped antenna elements mounted on an
5 upper surface of said first dielectric layer, said eight
6 antenna elements being aligned with one another and fabricated
7 from copper, each of said eight antenna elements being
8 positioned at an angle of approximately forty five degrees on
9 said first dielectric layer, said eight antenna elements being
10 adapted to receive GPS (Global Positioning System) data at a
11 frequency of approximately 1.575 GHz;

12 (d) each of said eight antenna elements including a pair
13 of tuning stubs located on adjacent sides of said antenna
14 element, said pair of tuning stubs for each of said eight
15 antenna elements allowing said eight antenna elements to be
16 fine tuned to an operating frequency for said GPS microstrip
17 antenna;

18 (e) an antenna feed network mounted on a bottom surface of
19 said first dielectric layer, said antenna feed network having a
20 main transmission line connected to a signal output for said

21 GPS microstrip antenna, said feed network having a plurality of
22 branch transmission lines connected to said main transmission
23 line at one end thereof, the opposite end of each of said
24 branch transmission lines including a pair of probes positioned
25 perpendicular to one another underneath one antenna element of
26 said eight antenna elements, one of said pair of probes for
27 each of said branch transmission lines having a length
28 substantially greater than the other of said pair of probes for
29 each of said branch transmission lines to provide for a ninety
30 degree relative phase shift between RF signals transmitted
31 through said pair of probes for each of said pair of branch
32 transmission lines resulting in a circular polarization and an
33 omni-directional radiation pattern being generated by said
34 eight antenna elements of said GPS microstrip antenna;

35 (f) a pair of identical filters integrally formed within
36 said main transmission line, said pair of filters isolating GPS
37 radio frequency signals from TM band signals over a frequency
38 range from about 2 GHz to about 7 GHz, each of said pair of
39 filters including a 7-section low pass filter and a 5-section
40 band stop filter;

41 (g) a diode limiter connected to said main transmission
42 line in proximity to said signal output for said feed network;

(h) an amplifier connected to said main transmission line in proximity to said signal output for said feed network, said diode limiter and said amplifier providing for an overall gain of approximately 27 decibels; and

(i) a second dielectric layer positioned below said first dielectric layer in alignment with said first dielectric layer, said second dielectric layer having a ground plane mounted on a bottom surface thereof.

18. The GPS microstrip antenna of claim 17 further comprising a continuous gap formed around first, second, third and fourth sides of each of said eight antenna elements, said continuous gap for each of said eight antenna elements having an electric field generated by said antenna element confined to said continuous gap.

19. The GPS microstrip antenna of claim 18 further comprising a copper plated ground mounted on a remaining portion of the upper surface of said first dielectric layer around the continuous gap for each of said plurality of antenna elements.

6 20. The GPS microstrip antenna of claim 20 wherein said
7 copper plated ground mounted on the upper surface of said first
8 dielectric layer is connected to the ground plane mounted on
9 the bottom surface of said second dielectric layer by a
10 plurality of vias which pass from said copper plated ground
11 through said first dielectric layer and said second dielectric
12 layer to said ground plane.